STEPHEN F. AUSTIN STATE UNIVERSITY

Department of Mathematics and Statistics

Math 305 – Introduction to Numerical Methods
Course Syllabus

Course description: Basic numerical and computational techniques used in solution of mathematical problems in the real world: approximation of functions, roots and systems of equations, numerical integration, interpolation and curve fitting, and machine computation.

Credit hours: 3

Course Prerequisites and Corequisites: MTH 234 and CSC 102 or equivalent.

Course outline: Approximate time spent

- **Equations in One Variable** 30%
  - Background
    - Calculus Review
    - Roundoff Error and Computer Arithmetic
    - Convergence, Algorithms and Computer Software
  - Numeric Solution Methods
    - Bisection, Secant, and Newton's methods
    - Error analysis and Accelerating convergence
    - Other methods for polynomials
- **Interpolation and Polynomial Approximation** 20%
  - Interpolation and the Lagrange method
  - Divided differences
  - Hermite Polynomials
  - Spline interpolation
  - Parametric curves
- **Numerical Differentiation and Integration** 25%
  - Numerical differentiation
  - Numerical Integration
    - Basic and composite quadratures
    - Other methods; Romberg, Gaussian, Adaptive
    - Multiple and Improper integrals
- **Numeric methods for Systems of Equations** 25%
  - Linear Systems
    - Norms of vectors and matrices
    - Eigenvalues and eigenvectors
    - Jacobi, Gauss-Seidel and SOR methods
  - Nonlinear Systems
    - Newton and Quasi-Newton methods
    - Steepest descent techniques

Student Learning Outcomes (SLO): At the end of MTH 305, a student who has studied and learned the material should be able to:

1. Recognize circumstances when numeric methods can and should be used. [PLO: 1, 5]
2. Use several basic numeric methods for solving equations of one variable. [PLO: 2, 4]
3. Find polynomial approximations for functions. [PLO: 2, 4]
4. Numerically approximate derivatives and integrals. [PLO: 2, 4]
5. Use methods for solving linear and nonlinear systems of equations. [PLO: 2, 4]
6. Use “current” computer software available for numeric solutions. [PLO: 4]

Program Learning Outcomes (PLO):

Students graduating from SFASU with a B.S. degree and a major in mathematics will:

1. Demonstrate comprehension of core mathematical concepts. [***Concepts***]
   (notion of theorem, mathematical proof, logical argument)
2. Execute mathematical procedures accurately, appropriately, and efficiently. [***Skills***]
   (calculus, algebra, routine, nonroutine, applied)
4. Demonstrate competence in using various mathematical tools, including technology, to formulate, represent, and solve problems. [***Problem Solving***]
   (calculus tools, algebra tools, applied tools, nonstandard problem solving)
5. Demonstrate proficiency in communicating mathematics in a format appropriate to expected audiences. [***Communication***]
   (written, visual, oral)

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